Systematic Review
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Effects of Monounsaturated Fatty Acids on Cardiovascular Risk Factors: A Systematic Review and Meta-Analysis

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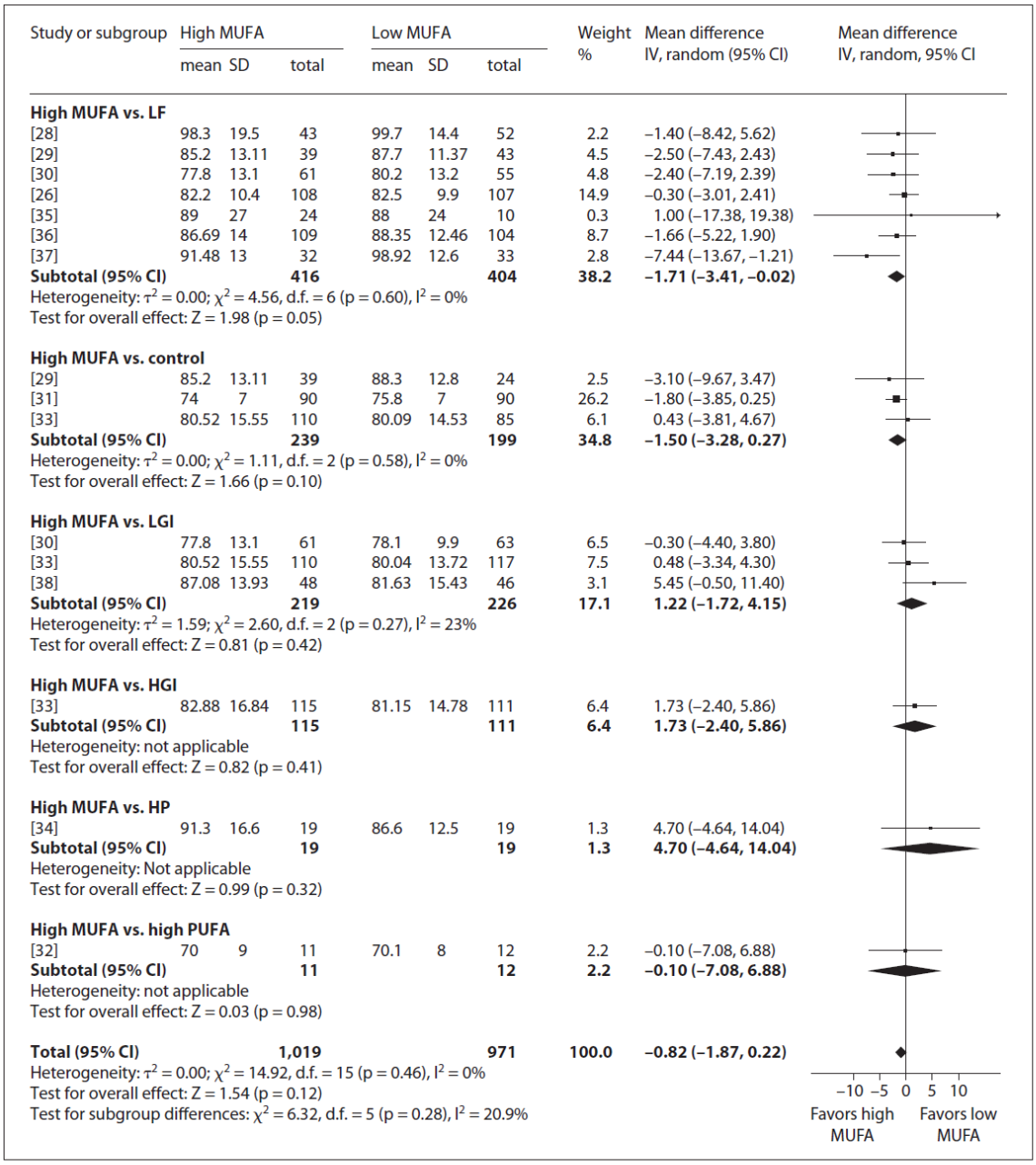

Fig. 1. Forest plot showing pooled WMD with 95% CI for weight (kg) for 12 randomized controlled high-MUFA diets. The different types of low-MUFA diets were separated into subgroups. For each high-MUFA study, the shaded square represents the point estimate of the intervention effect. The horizontal line joins the lower and upper limits of the 95% CI of these effects. The area of the shaded square reflects the relative weight of the study, within the respective meta-analysis. The diamond at the bottom of the graph represents the pooled WMD with the 95% CI for the 12 study groups.

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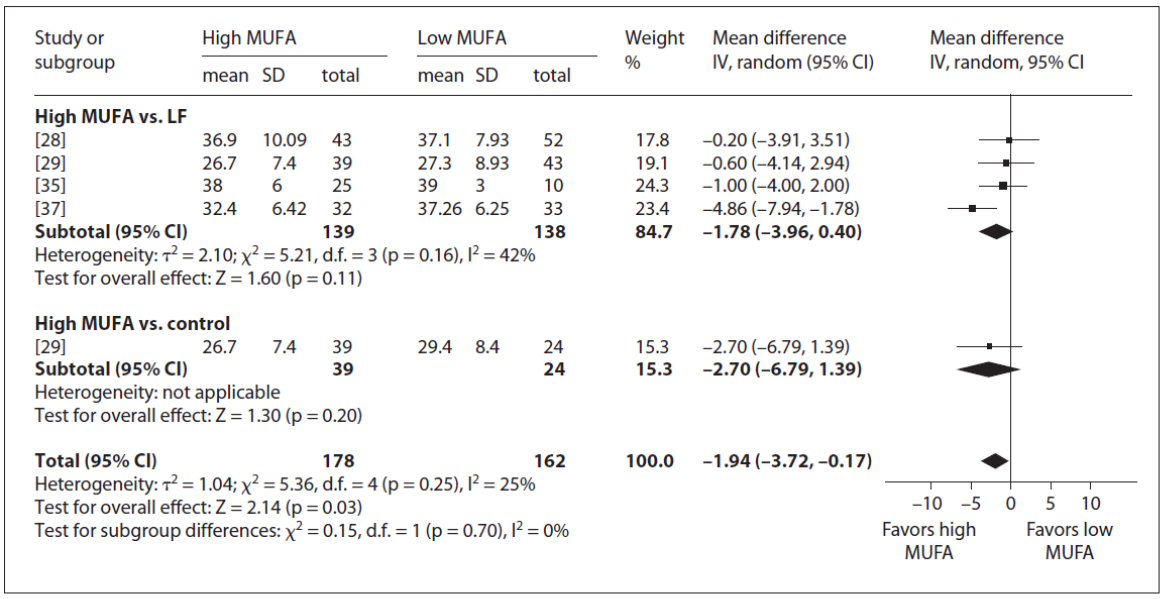

Fig. 2. Forest plot showing pooled WMD with 95% CI for FM (kg) for 4 randomized controlled high-MUFA diets. The different types of low-MUFA diets were separated into subgroups. For each high-MUFA study, the shaded square represents the point estimate of the intervention effect. The horizontal line joins the lower and upper limits of the 95% CI of these effects. The area of the shaded square reflects the relative weight of the study in the respective meta-analysis. The diamond at the bottom of the graph represents the pooled WMD with the 95% CI for the 4 study groups.

Conclusion

This systematic review included long-term RCTs (6 6 months) published until December 2010 which compared high-MUFA and low-MUFA diets. Outcome measures for obesity and its comorbidities were weight, WC, FM, TC, LDL cholesterol, HDL cholesterol, TG, SBP, DBP and CRP. Taken together, the results point to a beneficial effect of diets that contain more than 12% of TEC (in the form of MUFA) on important risk factors such as FM or SBP and DBP. Therefore, international dietary recommendations directed to treat or prevent obesity and its associated CVD could bear in mind specific percentages of MUFA within the range of the current Dietary Guidelines for Americans.

Monounsaturated Fatty Acids and Risk of Cardiovascular Disease: Synopsis of the Evidence Available from Systematic Reviews and Meta-Analyses

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Conclusions

In comparison, a considerably larger number of meta-analyses explored the effects of PUFAs on maintenance or reduction of body weight as well as biomarkers of impaired glucose metabolism or CVD/CHD than there are systematic reviews and meta-analyses dealing with the corresponding impact of MUFAs. Consequently, the international recommendations for PUFA are more consistent than those for MUFA, averaging a value of 10% of TEC for healthy persons for the most part. If MUFA recommendations are given at all, they vary between 12% and 25% of TEC, equaling a remarkable range of ~30–70 g/day for a 2.500 kcal-diet.

Prestigious authorities and organizations such as the National Institute of Medicine, the EFSA, the USDA and the ADA do not provide specific recommendation for MUFAs either for healthy people or for patients in need of diabetic or cardiovascular management.
In the present review, only meta-analyses were included, which indicates a high level of evidence, *i.e.*, from 2+ to 1+++ according to the Scottish Intercollegiate Guidelines Network indicate levels of evidence (Table 6). Apart from the fact that several meta-analyses and meta-regressions observed benefits of MUFA on cardiovascular risk factors, it should be noted that most meta-analyses did not report significant negative effects of a MUFA-rich diet on CVD risk factors.

With respect to the favorable influences of MUFA found in studies recruiting healthy volunteers or patients with diabetes and CHD respectively, some reservations still remain. Due to various inhomogeneities, the results of different studies are far from being conclusive. Thus, MUFA were compared to carbohydrate-rich diets, low fat diets or regimens focusing on PUFA or SFA. Moreover, the term MUFA-rich diet lacks a concrete definition leading to inconsistent amounts of MUFA used in the corresponding protocols. Some of the discrepancies in the findings of different studies can be explained by their uneven and maybe incompatible durations. Long-term biomarkers of glucose metabolism such as HbA1c will be *Nutrients* **2012**, *4* **2003** most likely not or just slightly improved following short-term interventions of 2–6 weeks. Nevertheless, in view of the importance of dietary interventions for the prevention and therapy of cardiovascular disease, monounsaturated fatty acid may represent a valuable tool in the modification of dietary regimens. There is strong evidence that by replacing SFA and carbohydrates with MUFA, various cardiovascular risk factors will be significantly improved.

The results of the different meta-analyses addressed in this review point to a beneficial effect of MUFA-rich diets on systolic and diastolic blood pressure as well as parameters of glycemic control. On the other hand, the impact of MUFA on blood lipids is still discussed controversially. While TG levels were decreased and HDL-cholesterol levels were increased following short-term interventions with higher amounts of MUFA, these findings could not be confirmed in long-term study protocols. Thus, there is no unanimous rationale for MUFAs in a therapeutic regimen. However, since no detrimental effects of MUFA-rich diets were

reported in the literature to date, there is no evidence speaking against the consideration of MUFAs in dietary guidelines. Further studies dealing with long-term effects of MUFA on biomarkers of obesity, diabetes, and cardiovascular diseases as well as clinical endpoints are needed to clarify the potential benefits of MUFA-rich diets in primary and secondary prevention.

J Nutr. 2012 Jul;142(7):1219-25. doi: 10.3945/jn.111.155283. Epub 2012 May 23.

Consumption of a high monounsaturated fat diet reduces oxidative phosphorylation gene expression in peripheral blood mononuclear cells of abdominally overweight men and women.

van Dijk SJ, Feskens EJ, Bos MB, de Groot LC, de Vries JH, Müller M, Afman LA.

Source

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Abstract

The Mediterranean (MED) diet is often considered health-promoting due to its high content of MUFA and polyphenols. These bioactive compounds can affect gene expression and accordingly may regulate pathways and proteins related to cardiovascular disease prevention. This study aimed to identify the effects of a MED-type diet, and the replacement of SFA with MUFA in a Western-type diet, on peripheral blood mononuclear cell (PBMC) gene expression and plasma proteins. Abdominally overweight men and women (waist: women ≥80 cm, men ≥94 cm) were allocated to an 8-wk, completely controlled SFA diet (19% daily energy as SFA), a MUFA diet (20% daily energy MUFA), or a MED diet (21% daily energy MUFA). Concentrations of 124 plasma proteins and PBMC whole-genome transcriptional profiles were assessed. Consumption of the MUFA and MED diets, compared with the SFA diet, decreased the expression of oxidative phosphorylation (OXPHOS) genes, plasma connective tissue growth factor, and apoB concentrations. Compared with the MED and SFA diets, the MUFA diet changed the expression of genes involved in B-cell receptor signaling and endocytosis signaling. Participants who consumed the MED diet had lower concentrations of proinflammatory proteins at 8 wk compared with baseline. We hypothesize that replacement of SFA with MUFA may improve health, thereby reducing metabolic stress and OXPHOS activity in PBMC. The MED diet may have additional antiatherogenic effects by lowering proinflammatory plasma proteins.

J Nutr Biochem. 2013 Apr;24(4):613-23. doi: 10.1016/j.jnutbio.2012.12.013.

Modulation of adipose tissue inflammation by bioactive food compounds.

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Source

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Abstract

Adipose tissue has an important endocrine function in the regulation of whole-body metabolism. Obesity leads to a chronic low-grade inflammation of the adipose tissue, which disrupts this endocrine function and results in metabolic derangements, such as type-2 diabetes. Dietary bioactive compounds, such as polyphenols and certain fatty acids, are known to suppress both systemic and adipose tissue inflammation and have the potential to improve these obesity-associated metabolic disorders. Mechanistically, polyphenolic compounds including non-flavonoids, such as curcumin and resveratrol, and flavonoids, such as catechins (tea-polyphenols), quercetin and isoflavones, suppress nuclear factor-κB (NF-κB) and mitogen-activated protein (MAP) kinases (MAPK) pathways while activating the 5' adenosine monophosphate-activated protein kinase (AMPK) pathway in adipose tissue. Dietary polyunsaturated fatty acids, such as eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), conjugated linoleic acid (CLA) and monounsaturated fatty acids (MUFA), such as oleic acid, also impart anti-inflammatory effects through several mechanisms. These include activation of AMPK and peroxisome proliferator-activated receptor gamma (PPAR-γ), as well as suppression of toll-like receptors (TLRs) and NF-κB pathway. This review discusses the major molecular mechanisms of dietary polyphenols and fatty acids, alone or in combination, which are responsible for adipose tissue-associated anti-inflammatory effects.

Br J Nutr. 2012 Aug;108(3):500-8. doi: 10.1017/S0007114511005812. Epub 2011 Nov 15.

Expression of proinflammatory, proatherogenic genes is reduced by the Mediterranean diet in elderly people.

Camargo A, Delgado-Lista J, Garcia-Rios A, Cruz-Teno C, Yubero-Serrano EM, Perez-Martinez P, Gutierrez-Mariscal FM, Lora-Aguilar P, Rodriguez-Cantalejo F, Fuentes-Jimenez F, Tinahones FJ, Malagon MM, Perez-Jimenez F, Lopez-Miranda J.

Source

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Abstract

Ageing is an important determinant of atherosclerosis development rate, mainly by the creation of a chronic low-grade inflammation. Diet, and particularly its fat content, modulates the inflammatory response in the fasting and postprandial states. Our aim was to study the effects of dietary fat on the expression of genes related to inflammation (NF-κB, monocyte chemoattractant protein 1 (MCP-1), TNF-α and IL-6) and plaque stability (matrix metalloproteinase 9, MMP-9) during the postprandial state of twenty healthy, elderly people who followed three diets for 3 weeks each: (1) Mediterranean diet (Med Diet) enriched in MUFA with virgin olive oil; (2) SFA-rich diet; and (3) low-fat, high-carbohydrate diet enriched in n-3 PUFA (CHO-PUFA diet) by a randomised crossover design. At the end of each period, after a 12-h fast, the subjects received a breakfast with a composition similar to the one when the dietary period ended. In the fasting state, the Med Diet consumption induced a lower gene expression of the p65 subunit of NF-κB compared with the SFA-rich diet (P = 0·019). The ingestion of the Med Diet induced a lower gene postprandial expression of p65 (P = 0·033), MCP-1 (P = 0·0229) and MMP-9 (P = 0·041) compared with the SFA-rich diet, and a lower gene postprandial expression of p65 (P = 0·027) and TNF-α (P = 0·047) compared with the CHO-PUFA diet. Direct plasma quantification mostly reproduced the findings.. These findings may be Our data suggest that consumption of a Med Diet reduces the postprandial inflammatory response in mononuclear cells compared with the SFA-rich and CHO-PUFA diets in elderly people partly responsible for the lower CVD risk found in populations with a high adherence to the Med Diet

J Agric Food Chem. 2011 Jul 13;59(13):7482-9. doi: 10.1021/jf201496h. Epub 2011 Jun 10.

Beneficial effects of dietary fish-oil-derived monounsaturated fatty acids on metabolic syndrome risk factors and insulin resistance in mice.

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Source

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Abstract

The aim of this study was to elucidate the effect of fish-oil-derived monounsaturated fatty acids (MUFAs) containing large amounts of C20:1 and C22:1 isomers on metabolic disorders in mice. Male C57BL/6J mice were fed a 32% lard diet (control) or a 27% lard plus 5% saury-oil-derived MUFA diet for 6 weeks. Dietary MUFA improved insulin resistance and alleviated metabolic syndrome risk factors by reducing blood glucose and lipids. These favorable changes may be attributed to an improved adipocytokine profile. MUFA ingestion resulted in favorable changes in mRNA expression of genes involved in glucose/lipid metabolism (SCD-1, CPT1a, UCPs, and CS) as well as inflammation (MAC1, MMP3, and SAA3) and alterations in fatty acid composition. Our data suggest that marine MUFA improved glucose/lipid homeostasis and hindered the development of metabolic syndrome in obese

Am J Clin Nutr. 2009 Dec;90(6):1656-64. doi: 10.3945/ajcn.2009.27792. Epub 2009 Oct 14.

A saturated fatty acid-rich diet induces an obesity-linked proinflammatory gene expression profile in adipose tissue of subjects at risk of metabolic syndrome.

van Dijk SJ, Feskens EJ, Bos MB, Hoelen DW, Heijligenberg R, Bromhaar MG, de Groot LC, de Vries JH, Müller M, Afman LA.

Source

The Division of Human Nutrition, Wageningen University, Wageningen, Netherlands.

Abstract

BACKGROUND:

Changes in dietary fat composition could lower the risk of developing metabolic syndrome. Adipose tissue is an interesting tissue in this respect because of its role in lipid metabolism and inflammation.

OBJECTIVE:

Our objective was to investigate the effect of a saturated fatty acid (SFA)- and a monounsaturated fatty acid (MUFA)-rich diet on insulin sensitivity, serum lipids, and gene expression profiles of adipose tissue in subjects at risk of metabolic syndrome.

DESIGN:

A parallel controlled-feeding trial was conducted in 20 abdominally overweight subjects. Subjects received an SFA diet or a MUFA diet for 8 wk. Plasma and subcutaneous adipose tissue samples were obtained, and insulin sensitivity was measured by using a hyperinsulinemic-euglycemic clamp. Adipose tissue samples underwent whole-genome microarray and histologic analysis. Plasma and adipose tissue fatty acid composition and concentrations of serum cholesterol and plasma cytokine were determined.

RESULTS:

Consumption of the SFA diet resulted in increased expression of genes involved in inflammation processes in adipose tissue, without changes in morphology or insulin sensitivity. The MUFA diet led to a more antiinflammatory gene expression profile, which was accompanied by a decrease in serum LDL-cholesterol concentrations and an increase in plasma and adipose tissue oleic acid content.

CONCLUSIONS:

Consumption of an SFA diet resulted in a proinflammatory "obesity-linked" gene expression profile, whereas consumption of a MUFA diet caused a more antiinflammatory profile. This suggests that replacement of dietary SFA with MUFA could prevent adipose tissue inflammation and may reduce the risk of inflammation-related diseases such as metabolic syndrome. This trial was registered at clinicaltrials.gov as NCT00405197.